CLAIMS

What is claimed is:

1. A receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor, said receptor-specific nanocontainer comprising:

a liposome having an exterior surface and an internal compartment;

a gene comprising a sufficient amount of genetic information to encode a short hairpin RNA , said gene being located within the internal compartment of said liposome;

a plurality of receptor targeting agents which are capable of targeting said receptor; and

a plurality of conjugation agents wherein each targeting agent is connected to the exterior surface of said liposome via at least one of said conjugation agents.

2. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **1** wherein said short hairpin RNA comprises a nucleotide sequence that is antisense to at least a portion of mRNA selected from the group consisting of mRNAs encoding the human epidermal growth factor receptor, mutants of the EGFR, HER2, HER3, HER4, fibroblast growth factor receptor (FGFR), platelet derived growth factor receptor (PDGFR), insulin-like growth factor receptor-1 (IGFR1), transforming growth factor-α (TGF–α), vascular endothelial growth factor (VEGF) or its receptor, VEGFR, altered protein kinases including the Bcr-Abl, c-Met, c-Kit, ras, raf, or CdKs.

3. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **2** wherein said short hairpin RNA comprises a nucleotide sequence that is antisense to a portion of human epidermal growth factor receptor mRNA, said human epidermal growth factor receptor mRNA comprising a nucleotide sequence having numbered nucleotides from 1 to 5532.

4. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **3** wherein said short hairpin RNA comprises

a nucleotide sequence that is antisense to a portion of said human epidermal growth factor receptor mRNA that is located between numbered nucleotides 2300and 3800.

5. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **4** wherein said portion of said human epidermal growth factor receptor mRNA is located between numbered nucleotides 2500 and 3000

6. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **5** wherein said portion of said human epidermal growth factor receptor mRNA is located between number nucleotides 2500 and 2600.

7. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **1** wherein said liposome exterior surface defines a sphere having a diameter of less than 200 nanometers.

8. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **1** wherein between 5 and 500 receptor-targeting agents are conjugated to the exterior surface of said liposome.

9. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **1** wherein said conjugation agent is selected from the group consisting of polyetheylene glycol, sphingomyelin and organic polymers.

10. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **9** wherein the molecular weight of said conjugation agent is between 1000 and 50,000 Daltons.

11. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **1** wherein from 100 to 10,000 conjugation agents are attached to the exterior surface of said liposome.

12. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **1** wherein said targeting agents are capable of targeting a receptor located on a solid tumor.

13. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **12** wherein said solid tumor is selected from the group consisting of brain tumors, liver tumors, lung tumors, spleen tumors, breast tumors, kidney tumors, prostate tumors, ovary tumors, eye tumors, gastrointestinal tumors, bone tumors, blood tumors, endocrine tumors, skin tumors, or lymph node tumors.

14. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **13** wherein said solid tumor is a brain tumor.

15. The receptor-specific nanocontainer for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **1** wherein said targeting agent is capable of targeting a receptor selected from the group consisting of insulin receptor, transferrin receptor, insulin-like growth factor receptor, leptin receptor, low density lipoprotein receptor fibroblast growth factor receptor.

16. A composition comprising the receptor-specific nanocontainer according to claim **1** and a pharmaceutically acceptable carrier for said receptor-specific nanocontainer.

17. A composition comprising the receptor-specific nanocontainer according to claim **16** wherein said cell to which said gene encoding said short hairpin RNA is to be delivered is located within an animal.

18. A method for delivering a short hairpin RNA to a cell having a receptor, said method comprising the step of administering to an animal an effective amount of a preparation comprising:

a) a receptor-specific nanocontainer comprising:

a liposome having an exterior surface and an internal compartment;

a gene comprising a sufficient amount of genetic information to encode a short hairpin RNA, said gene being located within the internal compartment of said liposome;

a plurality of receptor targeting agents which are capable of targeting said receptor; and

a plurality of conjugation agents wherein each targeting agent is connected to the exterior surface of said liposome via at least one of said conjugation agents; and

b) a pharmaceutically acceptable carrier for said receptor-specific nanocontainer.

19. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein said short hairpin RNA comprises a nucleotide sequence that is antisense to at least a portion of mRNAs encoding the human epidermal growth factor receptor, mutants of the EGFR, HER2, HER3, HER4, fibroblast growth factor receptor (FGFR), platelet derived growth factor receptor (PDGFR), insulin-like growth factor receptor-1 (IGFR1), transforming growth factor-α (TGF–α), vascular endothelial growth factor (VEGF) or its receptor, VEGFR, altered protein kinases including the Bcr-Abl, c-Met, c-Kit, ras, raf, or CdK.s

20. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **19** wherein said short hairpin RNA comprises a nucleotide sequence that is antisense to a portion of human epidermal growth factor receptor mRNA, said human epidermal growth factor receptor mRNA comprising a nucleotide sequence having numbered nucleotides from 1 to 5532.

21. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **20** wherein said short hairpin RNA comprises a nucleotide sequence that is antisense to a portion of said human epidermal growth factor receptor mRNA that is located between numbered nucleotides 2300 and 3800.

22. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **21** wherein said portion of said human epidermal growth factor receptor mRNA is located between numbered nucleotides 2500 and 3000.

23. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **22** wherein said portion of said human epidermal growth factor receptor mRNA is located between number nucleotides 2500 and 2600.

24. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein said liposome exterior surface defines a sphere having a diameter of less than 200 nanometers.

25. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein 5 and 500 receptor-targeting agents are conjugated to the exterior surface of said liposome.

26. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein said conjugation agent is selected from the group consisting of polyetheylene glycol, sphingomyelin and organic polymers.

27. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **26** wherein the molecular weight of said conjugation agent is between 1000 and 50,000 Daltons.

28. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein from 100 to 10,000 conjugation agents are attached to the exterior surface of said liposome.

29. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein said targeting agents are capable of targeting a receptor located on a solid tumor.

30. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein said solid tumor is selected from the group consisting of brain tumors, liver tumors, lung tumors, spleen tumors, breast tumors, kidney tumors, prostate

tumors, ovary tumors, eye tumors, gastrointestinal tumors, bone tumors, blood tumors, endocrine tumors, skin tumors, or lymph node tumors.

31. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein said solid tumor is a brain tumor.

32. The method for delivering a gene encoding short hairpin RNA to a cell having a receptor according to claim **18** wherein said targeting agent is capable of targeting a receptor selected from the group consisting of insulin receptor, transferrin receptor, insulin-like growth factor receptor, leptin receptor, low density lipoprotein receptor, fibroblast growth factor.